A STUDY ON THE HEPATOMODULATORY AND ANTI-OXIDATIVE EFFECTS OF METHANOLIC EXTRACT OF *SOLANUM TORVUM* SWARTZ FRUIT IN MONOSODIUM GLUTAMATE (AJINOMOTO) INDUCED WISTAR RATS

SYNOPSIS

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A study on the Hepatomodulatory and Anti-oxidative effects of methanolic extract of *Solanum torvum* Swartz fruit in Monosodium Glutamate (Ajinomoto) induced Wistar rats.

STATE OF THE ART

Liver is a vital organ in our body which manages various physiological functions such as production of bile acids, glycogen storage, lipid metabolism and detoxification. Due to functions such as detoxification and metabolism, liver is at constant risk against oxidative stress and inflammation (Mancak, 2023).

Liver diseases include conditions with varying pathological conditions such as hepatosis, liver adenoma, or liver cancer as well as acute or chronic inflammation of the liver (Srivastava & Srivastava, 2018). Obesity, viral infections, excessive alcohol intake and allopathic medications are among the most noteworthy causes of liver diseases (Islam Shawon et al., 2024).

The shift towards sedentary lifestyle accompanied with increased obtainability of canned or prepackaged food has led to increased exposure to artificial flavour enhancers among all age groups. (OLUWOLE et al., 2024). A chemical added to food to improve or augment its natural flavour is known as flavour enhancer. The most used among various food enhancers is Monosodium Glutamate (MSG), which is a sodium salt of Glutamic Acid and is commonly known as 'AJINOMOTO' (Dharita M. Joshi et al., 2023; Naveen Kumar et al., 2020). Monosodium Glutamate is found in a wide variety of foods, including processed meat, soup bases, flavoured snacks, spices, foods containing gelatin, cheese (roquefort and parmesan), instant noodle products, chips, fish sauce and bodybuilding protein powder which provides them an 'Umami' taste. (Henry-Unaeze, 2017).

The umami flavor was originally identified in kelp in 1908 and monosodium glu tamate starts to be produced industrially in 1909 (Sano, 2009). Since then there has been many advancements in the techniques for increasing the efficiency and yield of Monosodium Glutamate production.

Due to its flavourful and savoury taste it is widely used in household as well as commercially. It has been reported that overconsumption of Monosodium Glutamate can cause several health ailments including obesity due to which its use has been banned in some countries such as United States, Mexico, and Canada (Kazmi et al., 2017). It is also associated with conditions such as hepatotoxicity, nephrotoxicity, neurotoxicity, cardiotoxicity, alternation in glucose and lipid metabolism and negative effect on fertility (Bayram et al., 2023).

The intake of Monosodium glutamate leads to elevation in levels of ALP (alkaline phosphatase), ALT (alanine transaminase), AST (aspartate aminotransferase) accompanied by increase in Hepatic Bilirubin and decreased Albumin and total protein content which indicates hepatotoxicity (Omogbiya et al., 2021). Toxicity caused by Monosodium Glutamate also leads to generation of Reactive Oxygen Species (ROS) due to increased Lipid Peroxidation (LPO) and increased activity of Liver enzymes such as Glutathione-s-transferase (GST), catalase and super oxidase (Kazmi et al., 2017). Increased activity of GST leads to decreased level of Glutathione.

Conventional drugs used for treatment usually comes with serious side effects and cause hepatic damage over prolonged use (Pavithra et al., 2023). Herbal products have shown positive results when experimentally tested for prevention against hepatotoxicity (Saleem, n.d.). Plant based drugs are effective and often have less side effects. Thus, many modern medicines are often derived from plants. Several studies have indicated that these beneficial effects can be due to the presence of biologically active chemical compounds, called phytochemicals (Madrigal-Santillán et al., 2014). The phytochemicals are involved in antiulcerogenic, antioxidative, anti-cancerous, antimicrobial, anti-inflammatory and hepatoprotective activities. (Islam Shawon et al., 2024) (Innih et al., 2018a)

Due to its low cost and ease of availability as compared to allopathy medicines, around 60-80% of the population in developing countries still depend upon plant-based medicines (Amjad et al., 2020). With 7% of the total world's biodiversity, India is one among the 17 mega biodiversity countries in the world. Approximately 100 genera of plants used in traditional medicinal practices in various parts of the world belong to India (Prasathkumar et al., 2021). Majority of these medicinal plant genera lack well evaluated pharmacological safety and efficacy standards. Many communities around the world have incorporated indigenous food practices as the foundation of their diets without any scientific validation which contains phytochemicals like flavonoids and tannins and

provide them with multiple health benefits (Anwar et al., 2024). Thus, huge amount of research work is being carried in the identification, classification and thus, utilization of plant-based medicines.

Aegle marmelos (Rathee et al., 2018), *Andrographis paniculata* (Nagalekshmi et al., 2011), *Azadirachta indica* (Chattopadhyay, 2003), *Solanum torvum* Sw.(de Souza et al., 2023) have proven to have hepatoprotective or antihepatotoxic properties.

Solanum torvum Swartz belongs to the family Solanaceae. With its origin tracing all the way to West Indies and tropical America, it is widely distributed in South India, Himalayan foothills, and North-eastern India (Bishnoi, n.d.). It is commonly called Turkey berry, pendejera, devil's fig, pea eggplant, platebrush or susumber. In India it is also known as Bankatiya, Bharut (Hindi), Brihati (Sanskrit), Tita bagoon (Bengali). In various parts of Jharkhand, it is popularly known as ‘Kutumba’(Divakara & Prasad, 2015).

The shrub of *Solanum torvum* Swartz typically reaches a height of 2-3 meters and a basal diameter of 2 centimetres. The tubular, white flowers have five pointed lobes. The fruits resemble tiny green pea-like spheres and grow in clusters. In states of West Bengal, Bihar, Jharkhand, Odisha, Chhattisgarh, and North-Eastern India the unripped berries are enjoyed as luscious vegetables. It is found to have antimicrobial, antiviral, immune-secretory, antiulcer, antioxidative, anti-inflammatory, nephroprotective and hepatoprotective properties (Mohan et al., 2020).

Solanum torvum Swartz has been found to contain high source of phenolic and flavonoid content which possess free radical scavenging properties. (Kandimalla et al., 2015). (Innih et al., 2018b) found that *Solanum torvum* activated the hepatic Kupffer cells.

PROBLEM TO BE INVESTIGATED

In the present experimental work, attempts will be made to investigate the phytochemical constituents, the hepatomodulatory and antioxidative effects of methanolic extract of *Solanum torvum* fruit.

OBJECTIVES OF THE INVESTIGATION

The following objectives:

1. Collection and authentication of the *Solanum torvum* Swartz plant.
2. Evaluation of the organoleptic and physiochemical constituents.
3. Dosage determination.
4. To study the antioxidative activity.
5. Investigation of hepatomodulatory assay.

HYPOTHESIS

Solanum torvum Swartz has been customarily used to amend various ailments (Divakara & Prasad, 2015). In recent times there has been a shift towards plant-based medicines as they lack any significant side effects (Pavithra et al., 2023). Since the onset of its commercial production in 1909, Monosodium Glutamate (Ajinomoto) has been used in various snacks, fast food, soups and various canned food worldwide but its ill effects are still debatable (Yang et al., 2023).

Considering the above stated facts, I would like to make the following hypotheses:

1. The fruits of *Solanum torvum* Swartz may possess hepatomodulatory and antioxidative properties.
2. The above ameliorative property maybe due to its phytochemicals.
3. Monosodium glutamate may possess hepatotoxic properties.

RESEARCH DESIGN AND METHODOLOGY

1. Collection of plant material.
2. Standardization of plant material (Organoleptic characters, Physiochemical analysis).
3. Preparation of aqueous and methanolic extract of fruits of *Solanum torvum* Swartz.
4. Phytochemical analysis.

5. Procurement and acclimatization of laboratory animals.
6. Dose fixation.
7. Haematological assay and Serum-Biochemical profile assay (CBC, SGOT, SGPT, SALP, S.Protein, S.Albumin, S.Urea, S.Bilirubin, Total Cholesterol, S.TGL, VLDL, LDL, HDL)
8. Histopathological assay.
9. TEM.
10. Anti-oxidant assay

INSTRUMENTS TO BE USED

1. Centrifuge
2. Refrigerator
3. Incubator
4. UV- Spectrophotometer
5. Weighing machine
6. Water bath
7. Haemocytometer
8. Kit for various Biochemical parameter
9. Image analyser
10. Microtome

SIGNIFICANCE OF THE STUDY

Liver diseases accounts for over 20 lakh deaths every year (Alkandahri et al., 2021; El Rabey et al., 2021). Modern drugs used in curing hepatotoxicity are often accompanied by severe side effects. Thus, there is need to identify lesser toxic alternatives.

A very high percentage of the worlds' population, directly or indirectly depend upon plants for medicinal use. According to WHO, around 21,000 plant species possess nutritional values (Bulut et al., 2017).

If proven, the hepatomodulatory and antioxidative activity of *Solanum torvum* Swartz can be useful in prevention as well as in the treatment of liver diseases.

CONTRIBUTION TO THE EXISTING WORK

Even with the advancements in contemporary medicine, no medication can com pletely stimulate liver function, provide total protection, or support hepatocyte regeneration (Alkandahri et al., 2021; El Rabey et al., 2021). Studies have shown that *Solanum torvum* fruit possess various phytochemical constituents in generous quantity which are capable in delivering a pharmacological response (Hussain et al., 2023).

Thus, the study of hepatomodulatory activity along with the phytochemical analysis and antioxidative effect, will aid in the efficient understanding thereby paving the way for unworried incorporation of medicinal plants and their products in daily as well as therapeutic uses.

FUTURE WORK

Further research work could be carried in order:

1. To illuminate upon the underlying mechanism of action of herbal formulation of *Solanum torvum* Swartz.
2. To evaluate, formulate and optimize optimum dosage.
3. To evaluate safety and efficacy by conducting clinical trials.
4. To assess the effect of interaction between traditional medication and conventional medication.
5. To evaluate anti-cancerous activity.

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